$$D = .7185\,t + .486\,t^2\,(10^{-2}) + .96\,t^3\,(10^{-5}),$$

the logarithmic coefficients being

$$\log A = 9.856448 - 10,$$
$$\log B = 7.687127 - 10,$$
$$\log C = 4.984735 - 10.$$

From the above the relative ratio of air radiation per degree at different temperatures may be found.

For $t = 1°$, we have $dD/dt = 0.728$.

For $t = 100°$, we have $dD/dt = 1.98$.

Hence the radiation per degree at 100° is $1.98/0.728 = 2.72$ times greater than at 1°.

There remains before computing the value of the radiation constant to find the temperature gradient of the hot air column in the line of sight; laterally, the central portion of the air column only was used, and no correction in that direction is required. A thermal junction of thin copper and iron wires was moved by steps through the heated air column, and the readings of a galvanometer, through which the junction was connected, noted. The edge of the opening in the air chimney being called 0, its center would be at 5. The following readings were obtained:

TABLE 7.

Distance.	Deflection.
5.0	155
4.0	155
3.0	155
2.0	155
1.0	149
0.5	124
0.2	105
0.0	90
—0.2	75
—0.5	50
—1.0	22

The air flowing up past the outside of the warmed box gave the deflections for negative values of distance; the integral of these was nearly sufficient to balance the loss for less temperature within the range of positive values of the distance. By plotting a curve and integrating the positive and negative values with reference to distance, and radiation rate as derived from fig. 3, we find the actual air column to be 0.967 as effective as a column 10 centimeters deep, and at a temperature measured at its center.

We are now prepared to calculate the radiation constant, h. Assume that this is wanted for an excess temperature of 100°, a depth of 1 centimeter, and zero absorbing column. We have:

Average of all excess air temperatures observed	= 122°
Deflection for 122° from fig. 3	= 179
Deflection for 100° from fig. 3	= 130
Radiation per degree from lampblack at 4° excess; average	= .000249 (McFarlane.)
Ratio of air to lampblack radiation for zero absorbing column, from fig. 2	= .041

Therefore, $h = (130/179)\,(.000249)\,(0.1)\,(.041)\,(0.967)$
$= 0.000000717$ water-gram-degrees per square centimeter per second per degree excess temperature.

For 1° this becomes 0.000000264, and may be found with great facility from the curves given, or from their equations, for any temperature or depth of absorbing column within the limits of our observations.

If our surmise be correct that the freely transmitted part of moist air radiation is from its contained water vapor, amounting to 40 per cent of the whole, then the above numbers would become for dry air, 0.00000043 and 0.00000016, respectively.

NOTES AND EXTRACTS.

OBSERVATIONS AT TASIUSAK.

The Danish Government has recently published the record of meteorological, magnetic, and auroral observations made at Tasiusak, in the district of Angmagsalik, during the years 1898–99. This district was first explored and charted in 1884–85 by G. Holm, who found there a hitherto unknown tribe of Esquimaux. Consequently, in 1894, the Danish Government established here a commercial station and a mission. The station at Tasiusak is on the southwest shore of a small fiord on the southern coast of the island of Angmagsalik. The terminal moraines of great glaciers approach within 20 miles on the northwest and 50 miles on the north. The Atlantic Ocean occupies a semicircle of the horizon from northeast to southwest. An arctic current flows between Tasiusak and Iceland, whose nearest point is 300 miles to the eastward. The latitude of the station is 65° 36′ 40″ north, longitude 37° 33′ 26″ west of Greenwich. The cistern of the mercurial barometer is 17.3 meters above mean sea level. The records of the Richard self-recording instruments are published for each hour of the day, in full from November 1, 1898 to May 17, 1899. But observations in general are at hand for seven years during the interval 1883–1900, or whenever scientific expeditions have remained at that place. Some of the more remarkable meteorological measurements at the station are elucidated in this report by means of charts of the barometric regions over the North Atlantic Ocean. During seven years it was very rare to find a month where the maximum temperature did not rise above that of melting ice. Even in January and February, although the minimum temperatures are 28°, 29°, or 30° below zero on the centigrade scale, yet the maxima are 3°, 4°, or 5° above; that is to say, from 37° to 41° Fahrenheit. The relative humidity of the air falls as low as 11 per cent in September and November, but in other months it ranges between 25 and 46. From November to February the wind blows from the northern portion. In April and May the most frequent winds are south and west, but calms are still more frequent, amounting to from 40 to 50 per cent in November and February. The greatest velocity of the wind, measured by the Robinson anemometer, occurred during the storm of November 25–26, 1898, and amounted to 47.4 meters per second, or 95 miles per hour. At that time a center of low pressure was moving eastward, just to the north of Tasiusak and over Iceland. In general the centers of low pressure passed to the west of Stykkisholm, on the west coast of Iceland, twenty-two times during the winter of 1898–99, but to the south of Stykkisholm eighteen times. Those that pass to the west undoubtedly pass near Tasiusak. Elaborate descriptions are given of the aurora borealis, and the statistics show that the station is located in the northern part of the zone of maximum frequency, or even entirely north of this zone, which traverses Greenland at the sixty-first degree of latitude, and then passes between Iceland and Greenland, probably over the island of Jan Mayen and continues on between the northern part of Norway and the island of Spitzbergen.—*C. A.*

CLIMATOLOGY OF BALTIMORE, MD.

For some years past Dr. O. L. Fassig has been compiling a work on the climatology of Baltimore and its vicinity. This report will form volume 2 of the reports of the Maryland State Weather Service, and is already in press. Progress toward the completion of the report has been delayed, owing to the fact that almost all the work must be done outside office hours, that is to say, at night time. Unfortunately, on two occasions, fire has destroyed many finished plates, but nearly all the numerical calculations have been completed, and a final draft of the outline of the report can be submitted. The complete volume will comprise about 300 pages of text, 100 numerical tables, and 100 plates or figures in the text. If all goes well, the volume will be published in the autumn of 1904. It will be divided into the following chapters:

Introduction. General principles. Part 1.—Weather: The seasons; spring, summer, autumn, and winter for eighty-seven years. Storms affecting Baltimore. The weather of special days; February 22, March 4, etc. The weather of each decade. Weather forecasting; long-range forecasts; the moon and the weather; sun spots and the weather. Meteorological observations and organizations in Baltimore. Baltimore weather chronology. Part 2.—Climatology: Atmospheric pressure; mean hourly variations; annual march; extremes, etc. Temperature: diurnal march; hourly march; annual march; nonperiodic variations; water in the harbor; soil temperature. Humidity: hourly, monthly, and annual. Precipitation: diurnal, monthly, and annual; excessive; deficient; drought; snowfall. Hail. Fog. Cloudiness and sunshine. The winds: velocity; direction; diurnal, monthly, and annual. Electrical phenomena: thunderstorms; auroras.

Under the title, "The normal diurnal variation of the barometer at Baltimore," Dr. Fassig introduces a table of isopleths, or lines of equal quantity. These were, we believe, first introduced into meteorology in the French edition of Kaemtz's lectures, translated from the German by Charles Martins, Paris, 1843, in which edition a special chapter is added by Lalanne, a French engineer, on the graphic presentation of meteorological data. A chart of isopleths looks very much like a chart of isobars or a chart of contour lines in geography. Dr. Fassig describes his chart as follows: The mean hourly values of barometric pressure for Baltimore are presented in Table I for each month and for the year. The results for each season and for the entire year are also shown graphically in fig. 1 and fig. 2. In Table II, the same values are expressed in terms of departures from the average value for the entire day.

These tables and diagrams reveal for Baltimore the characteristic double barometric curve so well known to the meteorologists from the results of analyses of observations from all parts of the world, with perhaps minor peculiarities due to local conditions. The fluctuations are well marked in all months of the year, the amplitude varying from 0.060 inch in August to 0.071 inch in March. In fig. 2 the distribution of pressure is represented by a method not frequently employed, but one which shows clearly and in compact form the successive changes from hour to hour throughout the year. Upon a system of coordinates representing the hours of the day and the months of the year, isobars, or lines of equal pressure, are projected in such manner as to enable one to find the exact pressure at any hour of any month. For example, to find the average pressure at noon, in April, you run down the vertical line marked noon until the horizontal line marked April is intercepted, and find the isobar of 29.875. This method enables us also to see at a glance the chief characteristics of the seasonal distribution, further emphasized by differences in shading, the lighter shades indicating the lower pressures of the warm months, and the darker shades the higher pressures of the colder months.

In the next section Dr. Fassig has taken the trouble to compute the barometric variations on 60 clear days in January and February, and 30 clear days in July, as also variations on the same number of cloudy days in those months. The curves for the cloudy days coincide very closely with the general curve for all kinds of weather during the summer months, but diverge decidedly during the winter months. The curve for totally clear days also diverges from the normal in the winter during the night and early morning hours. The following section has an especial interest at the present time, on account of the attempts that are being made to explain the ultimate origin and nature of the regular barometric variations.

THE DIURNAL BAROMETRIC WAVE.

The diurnal variations of the barometer described in the preceding paragraphs are not simply of local occurrence, but are part of a general phenomenon extending over the greater portion of the earth's surface. The maximum and minimum phases pointed out occur in all localities at approximately the same hours of local time. As stated above, this pressure wave, as it may be called, has its greatest development in or near the equatorial belt, and diminishes in amplitude with distance north and south of the equator. It has some resemblance to a double atmospheric wave passing completely around the earth from east to west every twenty-four hours, having a velocity at the equator of about 1000 miles per hour. By plotting upon a map of the world the departures from the normal daily pressure for successive hours of the day at a large number of stations uniformly distributed over the Northern and Southern hemispheres, and joining such stations as have equal departures of pressure for the same hour, we have presented to us four systems of pressure distribution, consisting of two areas of low pressure and two areas of high pressure. These systems completely circle the globe and closely resemble in form the cyclonic and anticyclonic systems of the middle latitudes, but differ from them, among other things, in covering an area vastly greater, and in moving in the opposite direction. The diurnal fluctuations of the barometer are the local evidence of this vast double atmospheric wave passing around the globe daily. The westward propagation of these waves near the equator is represented in fig. 5 [not reproduced], the curve showing the time of occurrence of the different phases of the double wave, its amplitude, and the direction of propagation along the path of greatest development. The character of these waves is further indicated in fig. 6 [not reproduced], in which the successive areas of high and low pressure are exhibited at the time of their maximum development in passing from east to west across the North and South American continents.[1]

This double atmospheric wave, or tide, is so intimately associated with the apparent diurnal movements of the sun that the conclusion is almost irresistible that the pressure changes are due primarily to changes of temperature. This relationship has not yet been satisfactorily demonstrated to be that of direct cause and effect, but there seems to be a general consensus of opinion that the primary maximum and the primary minimum phases of pressure are direct effects of the sun's heat. The theory advanced many years ago to account for the chief maximum and minimum phases seems plausible. At the time of day, between 9 a. m. and 10 a. m., when the atmosphere is being warmed most rapidly and the tendency of the air to rise in consequence is greatest, the upper and colder layers impede this upward movement, resulting in a temporarily increased tension at the surface of the earth. When this tension is relieved the barometer begins to fall, reaching its lowest point about the middle of the afternoon when the upward movement of the warm air may be assumed to be least impeded.

As has already been stated above, the pressure wave attains its greatest amplitude in the equatorial belt where the diurnal temperature changes are greatest, and over the continental masses north and south of the equator where the diurnal range of temperature is most marked.

According to Dr. Hann,[2] in seeking an explanation of the diurnal variations of the barometer: "We had better deal with the action of the sun on the upper strata of the atmosphere and treat this as the principal cause. The actinometrical observations show us that these upper strata absorb a considerable amount of heat. The diurnal heating action of the sun on the upper strata would harmonize far better with the general uniformity of the daily barometric oscillation along the different parallels of latitude as well as with its general independence of weather. We need not quite exclude local influences, but these seem to be more of a secondary character." This view is also held by Lord Kelvin, who seems to have been the first to suggest this explanation.

C. A.

METEOROLOGY AT MONTPELLIER, FRANCE.

The meteorological observatory at Montpellier represents the meteorological commission of the Department of Hérault as well as the National School of Agriculture at Montpellier. The observatory and the commission began its work in 1872, or even earlier. The publication of the meteorological bulletin of the Department of Hérault began in 1873, and there has just been published a general index to the 31 volumes, 1873–1903, together with a few words as to the general activity of the institution.

In 1864 the Paris Observatory proposed to make a special study of the progress of thunderstorms through France. The Department of Hérault appointed a special commission to assist

[1] Fassig, O. L. The Daily Barometric Wave. Bull. No. 31, U. S. Weather Bureau. 8vo. Washington, D. C. 1902. Pp. 62–65, 12 pls.

[2] Hann, J. The Theory of the Daily Barometric Oscillation. Quart. Jour. Roy. Met. Soc. London, 1899. P. 40.